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Managing Design Performance

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James L. Hathaway
Jordan W. Cassell

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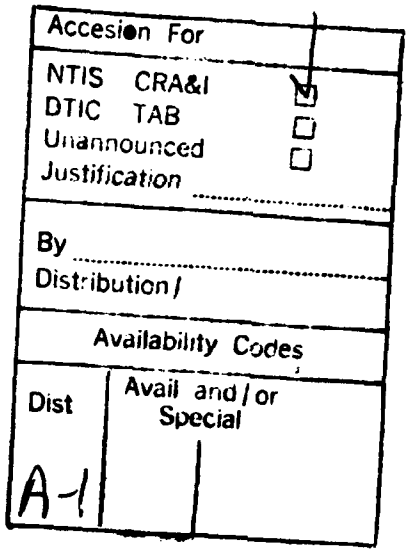

James L. Hathaway
Jordan W. Cassell

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Logistics Management Institute
6400 Goldsboro Road
Bethesda, Maryland 20817-5886

Executive Summary

MANAGING DESIGN PERFORMANCE

In 1991, the U.S. Army Corps of Engineers (USACE) established target rates for its planning and design services to provide a gauge for district performance. For the most part, districts have found those targets difficult to meet, partly because they were based upon performance factors derived from 1987 – 1990 data collected during a time of robust construction activity and partly because additional design requirements have been imposed and are expected to be completed within historic funding levels. Had the target rates been met by all districts in FY92, planning and design in the USACE would have cost $33 million less.

We believe that if the targets are adjusted somewhat, the districts can meet them. However, some changes must be made in the planning and design process to do so.

- Project planning: Planning and design funds are being used for planning functions after design has begun that are the responsibility of the customer. *We recommend tighter project screening by the customer and USACE divisions to improve customer planning and reduce the planning impact during design.*
- Architect-engineer contracting: *As recommended in previous studies, we believe that higher command priority should be brought to bear on improving the A-E contracting process. We recommend updating the time standards to award A-E contracts and publicizing successful techniques that districts have used to streamline their contracting processes.*
- Design reviews: *We recommend that guidance for design reviews, including criteria for establishing level of effort, types of reviews, and responsibilities of reviewers, be updated.*
- Information systems: Most districts have developed local information systems for planning and design cost management. *We recommend that the USACE accelerate its fielding of the Corps of Engineers Financial Management System and the Project Management Information System.*

We recommend that the USACE also take the following actions to improve control over planning and design costs:

- *Prepare a brochure that describes for the customers the basis for planning and design costs and how they can help control those costs through better planning and communication.*
- *Initially fund design projects with seed money ($10,000) so those projects will not have to wait for funds or utilize other funds.*
- *Initiate a review of computer-aided design and drafting (CADD) capability to evaluate benefits and costs and to update policies and guidance in acquiring and managing CADD systems.*
- *Explore print-on-demand capability with the Navy Printing and Publications Office to control reproduction costs and reduce internal distribution of plans and specifications.*
- *Expand the participation of line managers in district and departmental overhead cost decisions. Plan centrally managed programs early to gain district support, and obtain funding (billback) commitment to avoid unanticipated annual rate impacts.*
- *Eliminate local construction guide specifications and, if necessary, dispatch a tiger team to those districts needing help to utilize Corps-wide specifications.*
- *Develop a national design manual to replace district design manuals.*

We believe that the greatest potential for reducing the planning and design costs lies in the Corps-wide development of design quality management teams. Those multidisciplinary teams would focus on customers' needs, recognize the value of each other's contribution, and continually seek improvement to the design process. *We believe such design quality management teams can make the greatest single improvement in the efficiency of the planning and design program.*

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FIGURES

CHAPTER 1

USACE DESIGNERS CHALLENGED

PLANNING AND DESIGN ISSUES

Since 1990, the U.S. Army Corps of Engineers (USACE) has experienced an increase in its cost of providing planning and design services. To learn the primary reason for those increases and how to control them better, USACE tasked the Logistics Management Institute (LMI) to review, based on its past research of USACE planning and design services, the methods for acquiring and producing those services and recommend changes that could improve cost control.

Customers seeking design and construction services from the USACE have become more sophisticated in their facility requirements and expect a quality product. In this context, a quality product is one that satisfies the customer's requirement, is delivered on time, and is produced within its budgeted cost. A design process founded on quality principles must be effective in each of those three areas – need, timeliness, and cost – if it is expected to produce quality products.

The Corps has realized continuing success in meeting its customer needs. The Corps also has a reputation of maintaining public confidence that its products will be safe and sound investments. However, like most other government agencies, the Corps is facing a series of issues and changes, and those must be dealt with if USACE expects to maintain that reputation.

Change – The Expected Constant

Applying its considerable technical capability to the customer's requirements can present a formidable challenge to the Corps. Customer representatives and the military leaders often change during the life of a project, and original thinking and views also change. In some cases, projects can be programmed as early as 10 years before construction funds are approved by Congress, and the rationale supporting an original project requirement as well as its budget estimate often must be revamped or scrapped entirely.

Those projects whose scope, siting, or other criteria change are frequently delayed until issues can be resolved. Similarly, funding changes result in delays that can cause projects to slip into another fiscal year. Other delays in the contracting process, particularly in acquiring architect-engineer firms for planning and design, add to the time span for delivering projects. Of course, some projects can be "fast-tracked," i.e., given special attention, but that usually affects other projects by disrupting the normal processes. Delivering products to customers on time is difficult, particularly when some of the disruptive events are not within USACE's sphere of control.

Shrinking Funds Base

Funds for the planning and design (P&D) of military construction (MILCON) projects are provided annually through a separate account of the MILCON appropriation. That account must be sufficient to fund the completion of designs for all projects expected to be constructed over the following 2 years. The Army and Air Force installations and major commands must clearly define their needs to ensure that design fund requirements keep pace with the construction projects. Allocating those limited design funds among districts and projects is perhaps more art than science because of unpredictable changes that occur.

Funds needed to design non-MILCON projects, such as operations and maintenance (O&M) repair projects, are less subject to the vagaries of Service-wide allocation. The customer, however, must directly fund both the design and construction costs of those small projects. Those projects must be performed along with the larger MILCON projects at the districts, and unless separate handling is provided, those smaller projects can become embroiled in the swirl of changes and priorities inevitably affecting the larger and usually more complex projects.

Thus, managing the design process is challenging. The successful design managers seek to diminish the amount of change, moderate its impact when it occurs, and improve the design process to better accommodate it. Change, often resulting from a revised requirement, invariably affects timeliness and, often, product cost. Quality design requires a partnership effort between the customer and the designer. Reacting to change in a partnering environment helps to ensure success.

IMPROVEMENT IS NEEDED

An earlier LMI study found that the formula used to estimate funds required for design of future-year construction projects understated the requirement.[1] As the MILCON program has continued to decline, the requirements have become further understated. Additionally, the shortfall of design funds has been adversely affected by the overall decline in the economy. As illustrated in Figure 1-1, the construction industry represented by the building cost index has been relatively flat; over the 8-year period, 1985 – 1993, the annual increase averaged only 2.3 percent. Increases in design costs have been similarly depressed, but to a lesser degree. Increased costs attributed to the Federal Employees Retirement System and medical benefits have affected in-house P&D costs. Additionally, salaries for design staffs have risen faster than wages for the construction trades. These increases have resulted in an increase in the ratio of design to construction costs even though the design effort remained constant or declined. Although DoD needs to improve its rationale for obtaining design dollars in its annual budget process, the construction agents, including USACE, must also improve their management of the P&D resources and processes they use to produce designs.

The Corps has attempted to consolidate its engineering and design functions into fewer than the current 38 districts to become more efficient, but the final result of that initiative is highly uncertain and dependent upon congressional and Secretary of Defense decisions. Until consolidation occurs, the districts will be forced to accept the overhead burden of 38 design organizations (26 of which provide design support for military programs) and will continue to "broker" work between districts to maintain minimum design capability at each. Since the workload is declining faster than corresponding reductions in the design staffs, the tendency is to retain more work in-house rather than contract out to architect-engineer (A-E) firms. Districts relying too heavily on in-house capability lose the flexibility to tap into the skills and capacity of the A-E market. As workload continues to decline, that tendency will make it difficult for districts to meet the USACE goal of performing 20 to 30 percent of the workload in-house.

These factors and others more directly related to internal processes require that the USACE undertake a self-assessment of its methods of doing business. USACE

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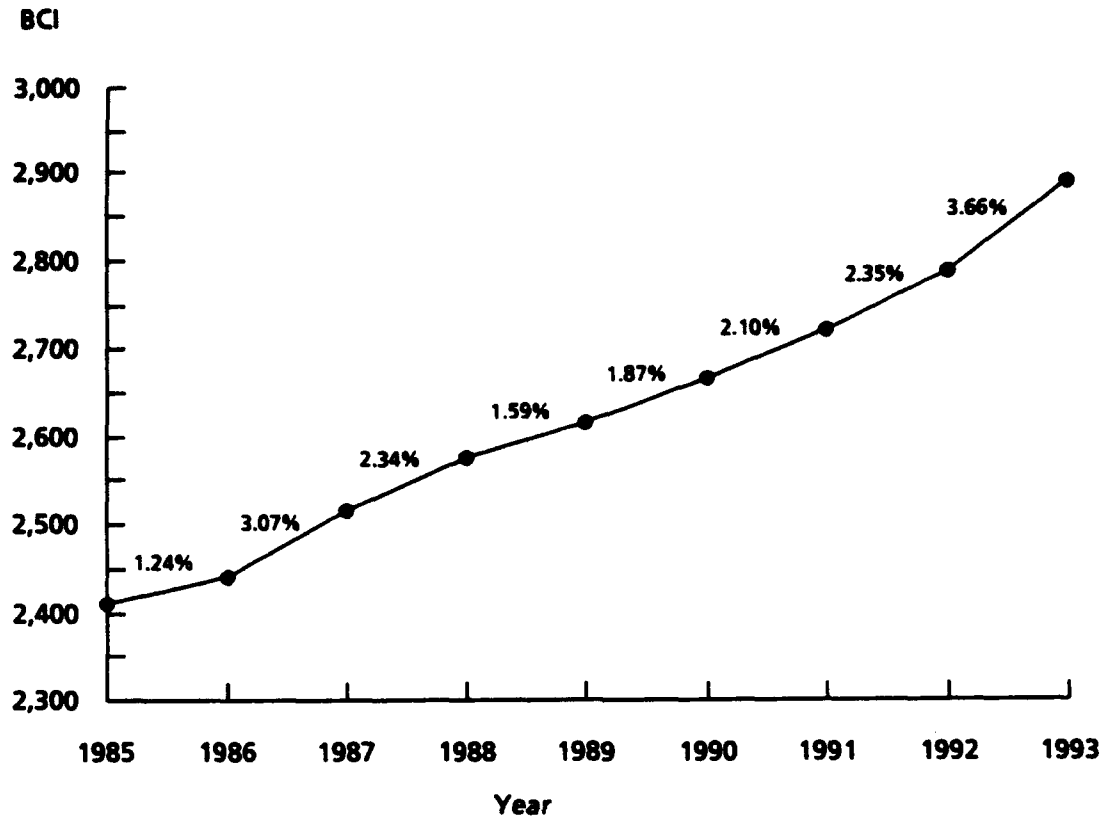
[1]LMI Report AR001R1, *Military Construction Planning and Design Funding Requirements*, James L.Hathaway, Eric M. Small, and Jeffrey Hawkins, November 1990.



Source: *Engineering News Record*, March 30, 1993.
Notes: Percentages show annual increase. BCI = Building Construction Index.

FIG. 1-1. BUILDING COST INDEX

needs to streamline its operations to remain competitive and deliver quality products to its customers.

PLANNING AND DESIGN TARGETS

In 1991, USACE published a set of targets for P&D costs based on historical averages for different fund types and project size categories. That set of targets, displayed in Appendix A, was established by Headquarters, USACE (HQUSACE), to gain better control over P&D costs. Data reported to HQUSACE using the Automated Management and Progress Reporting System (AMPRS) are summarized by district and division to gauge performance in design cost control. Reported quarterly at the Command Management Reviews, this initiative has focused attention of the top USACE leaders on P&D costs.

The P&D targets, based on design cost as a ratio of total program amount (PA) for each project, were developed from a historical baseline reflecting past performance. Factors for the period 1985 – 1988 were notably lower than those for more recent years. During that earlier period, the Corps managed to design projects at a lower P&D cost rate because of an increased workload with minimal increases in staff.

In a 21 June 1991 memorandum to the eight divisions and their districts responsible for military design projects, HQUSACE asked them to evaluate proposed FY92 and FY93 P&D targets and to provide rationale for the cost increases in P&D. The responses to that memorandum were incisive and are summarized in Appendix B. The districts offered substantial rationale to illustrate why P&D costs have increased, and a number of suggestions for reducing costs were made. Of significance was a universal belief that P&D cost impacts were far greater in areas outside the control of the engineering divisions than from within. Most notable were the costs resulting from greater customer demands; increased district overhead; Headquarters reporting and billbacks; increased project costs, i.e., staffing the new programs and project management (PPM) offices; more intense A-E contract administration procedures; and a high level of customer uncertainty and changes. That information has helped to provide areas to examine in this study. As might be expected, the districts were not enthusiastic about implementing targets; however, most recognized that overall management of P&D costs was needed and that targets, even though challenging, were a valid measuring device.

DESIGN COST FACTORS

After focusing attention on the cost of P&D through the use of targets, attention must then shift to examining the components of those costs.

Staffing Level

Maintaining the proper design office staffing level is crucial to maintaining a cost-effective operation. An in-house design target of 25 percent of the total design workload requires a core capability to execute a significant design workload. Given normal circumstances, the annual workload will fluctuate more rapidly than will the staffing level. The percent of in-house work, therefore, should fluctuate in a range from 20 to 30 percent, with 25 percent remaining as a target. The USACE districts performed an average of about 25 percent of their workload in-house during 1993;

however, 12 of the 26 reporting districts fell outside (above or below) the target range of 20 to 30 percent. As large swings in workload occur over extended periods, management must adjust staffing levels and maximize the use of staff capabilities. In periods of rapid workload growth, the A-E community can assist, but when the workload is significantly reduced, staffs must also be reduced to avoid major design cost growth.

Analysis of staffing requirements is beyond the scope of this study; however, we note that USACE has initiated a review of its Corps of Engineers Resource and Military Manpower System (CERAMMS), a model used to allocate manpower on the basis of expected workload. That review, combined with continuing USACE process action team initiatives, will help sharpen the focus on staffing requirements for effective Corps design organizations.

Overhead and the Total Labor Multiplier

Virtually all organizations – public and private – carry some burden associated with the cost of doing business. The components of USACE overhead are similar to other government agencies. Fringe benefits, leave, travel, training, and rent payments are among the more common elements comprising overhead. Those costs added to the individual departmental overhead costs at a district or division combine to form an organization's total labor multiplier (TLM). An hour of direct labor charged to a customer's project, therefore, would be billed at the rate of the individual's salary multiplied by the local TLM. The TLM for USACE averaged 2.63 in FY91 for the Corps military design programs. District TLM rates were affected by many changes during FY92, including a revised definition of departmental overhead and reduced workload and introduction of the PPM concept at all Corps districts and divisions. The net effect appeared to be minimal. The FY92 TLM average dropped by 0.05 to 2.58.

Although this rate may appear high to customers, it is not out of line with private-sector A-E firms. The net multiplier for A-E firms for the period 1989 – 1993 averaged 2.77.[2] Nevertheless, it is important that all design cost elements, including overhead and special design services, be carefully managed. All district and division

[2] *1993 PSMJ Financial Statistics Survey*, Practice Management Associates, September 1993, page 161.

managers must be actively engaged in command-wide efforts to control overhead costs.

Design Process

Many factors that influence design performance are embedded in the processes used to produce designs – whether those designs are performed by in-house staffs or by A-E firms. The USACE has begun intensive efforts to apply the principles of total quality management to the design process. Process factors such as review procedures, information collection and reporting, design automation, contracting procedures, and customer input all affect design performance and product cost. Selecting areas for process improvement and implementing changes should lead to actions that streamline the design process and improve cost control.

SUMMARY

Producing quality products; controlling staffing, overhead, and other costs under the imperatives of a declining workload; and streamlining the design process all combine to present major challenges to USACE designers and design managers. In Chapter 2, we present a more detailed explanation of the design targets with recommendations that the targets be modified and updated to reflect current conditions. Chapter 3 summarizes our findings and conclusions on improvements that can be made in P&D cost performance. In that chapter, we group our findings into five categories: design process, information systems, design automation, other P&D cost factors, and the design quality management team.

CHAPTER 2

PLANNING AND DESIGN TARGETS

Establishing targets or goals is an effective method for organizations to determine where they should be heading, how they compare with other organizations providing similar services or products, and how they should gauge their progress in achieving those targets or goals. For that method to be effective, the targets must be realistic yet challenging.

TARGET DEVELOPMENT

The P&D targets first published in September 1991 elicited various reactions ranging from skepticism to disbelief. Those reactions were expected, and many of the criticisms were based on well-founded experience. The analytical basis for the targets was questioned, as was the necessity.

Supported by LMI's research of historical costs and manpower requirements, HQUSACE determined that the targets could be developed by fund categories since the available data for that field were more robust and accurate than those for alternative data fields (such as DoD facility category codes or customer accounts). The Automated Management and Progress Reporting System (AMPRS) data provided the only comprehensive source of information from which a basis for target development was feasible. Distilled from an initial data base of more than 10,000 projects dating from as early as 1980, a set of projects with designs completed from FY85 through FY90 was selected as the historic baseline. Over 5,000 projects were arrayed by program fiscal year, program size, and 36 fund-type categories.

Table 2-1 lists the nine consolidated fund-type categories developed for the P&D targets. The fund types for host nation support and foreign military sales were excluded from the categories, since the nature of design performance for those unique programs falls outside the design target parameters. Design-build projects were also excluded from this analysis. In many of the fund-type categories, only a few projects were completed in a single fiscal year, and thus, they had to be consolidated with other similar fund types to make target implementation manageable. Although the DoD medical fund type (DoD-M-fund type) contained relatively few projects, USACE

assigned them separate targets because of their complexity and the extensive management oversight such projects require. A complete list of the fund types that make up each of the target fund-type categories is presented in Appendix C.

TABLE 2-1

FUND-TYPE CATEGORIES

Target fund type
MCA – Military Construction, Army
MCAR – Military Construction, Army Reserve
MCAF/AFR – Military Construction, Air Force/Air Force Reserve
Other – Military Construction, Other
PBS – Production Base Support
FHA/FHAF – Family Housing, Army/Air Force
OMA – Operation and Maintenance, Army
OMAF – Operation and Maintenance, Air Force
DoD-M – Department of Defense, Medical

Size categories by PA were determined on the basis of the number of projects and the range of cost ratios. The four size categories shown in Table 2-2 were selected as the appropriate divisions for size. Because a relatively high cost is associated with small projects, we determined that projects under $1 million should be divided into two categories (<$500,000; and $500,000 – $1 million).

TABLE 2-2

PLANNING AND DESIGN SIZE CATEGORIES

PA < $500,000	PA = $500,000 – $1 million	PA = $1 million – $5 million	PA > $5 million

Historic costs based on projects in the above fund-type and size categories provided the basis for establishing the P&D targets. Adjustments were based on field input and other senior-level judgment. The historic rates and the FY92 target rates are shown in Table 2-3.

TABLE 2-3

PLANNING AND DESIGN TARGET RATIOS (P&D/PA)

Fund type	Less than $500k (for FY)			$500k – $1 million (for FY)			$1 million – $5 million (for FY)			Greater than $5 million (for FY)		
	85 – 87	87 – 89	Target	85 – 87	87 – 89	Target	85 – 87	87 – 89	Target	85 – 87	87 – 89	Target
MCA	.119	.120	.120	.110	.109	.110	.082	.091	.090	.059	.063	.060
MCAR	.097	.107	.100	.095	XXX	.095	.075	.087	.075	.049	.041	.045
MCAF/AFR	.194	.196	.170	.130	.151	.135	.094	.099	.095	.062	.069	.065
Other	.159	.126	.155	.115	.091	.115	.078	.072	.075	.040	.043	.040
PBS	.156	.190	.170	.085	.121	.115	.067	.077	.075	.065	.063	.065
FHA/FHAF	.095	.087	.090	.055	.061	.060	.039	.048	.045	.012	.015	.015
OMA	.120	.121	.120	.066	.071	.070	.036	.049	.045	.017	.022	.025
OMAF	.086	.094	.090	.060	.071	.070	.038	.039	.040	.036	.024	.025
DoD-M	.220	.172	.150	.220	.172	.125	.208	.175	.125	.034	.075	.105

APPLICATION OF TARGETS

Application of the targets was not well understood initially. The greatest concern expressed by USACE district and division managers was that many individual projects had characteristics that often would cause the project design cost to vary from the target rate. Unusual site problems, customer changes, modification of existing structures, environmental constraints, and nonstandard equipment or material requirements were among the concerns often cited. As might be expected, no comment was made about those less complex projects that could be completed at a rate below the target rate.

Another concern expressed by design managers was the use of step functions, rather than smooth curves to develop the targets. For example, an Air Force MILCON project with a PA of $975,000 would use a design ratio of 0.135 compared with a similar project with a PA of $1 million with a design ratio of 0.095. The resulting difference in design cost targets exceeds $36,000, although the difference in PA is only $25,000. A step function was chosen because of the simplicity of applying it to groups of projects rather than to individual projects. Unfortunately, some customers have misunderstood the intent of the targets and expected the districts to produce each design within the target rate.

A third criticism of the targets was the inclusion of O&M-funded projects. They represent a sizable number of projects (33 percent of the FY92 projects); however, their overall dollar value is relatively small (8 percent of the FY92 PA). The cost of an O&M project is usually small, and its design requirements vary from a simple pavement overlay to a complex modification of a laboratory facility. Targets for design of individual O&M projects are less meaningful than those for more traditional construction projects.

The target was to serve as a collective gauge for the sum of all projects in each district rather than as a measure of each individual project. The target for each fund-type and size category should result in a composite rate derived for each district on the basis of the actual projects completed. The composite rate allows for individual project variations. A sample composite rate calculation for a hypothetical district workload, shown at Appendix D, was published in the USACE guidance memorandum, CEMP-ES (1110), dated 24 September 1991, that implemented the target rates.

In 1991, LMI developed a design cost-estimating model to answer the question of how to establish a fair and reasonable design rate for each customer's individual project.[1] That model, which was derived from a family of curves based on historical data, enables the design manager to tailor the project and its costs to the customer's needs. Special requirements, such as renderings, environmental conditions, site visits, or reproduction costs, can be incorporated into the estimate. In principle, the sum of cost estimates for all projects derived from the model should approximate the overall composite target rates for each district.

CURRENT TARGET PERFORMANCE

Measurement of the P&D performance against the target rates began with data from the second quarter of FY92 (1 January – 31 March 1992). As a result, the visibility of design cost was clearly elevated as a command interest issue. Figure 2-1 displays the summary result of the FY92 performance by the four size categories against their composite targets. As shown, the smaller projects – those less than $1 million – exceeded their targets by approximately 3 percent. The projects

[1]LMI Report CE006R1, *Improving Management of Military Construction Planning and Design*, James L. Hathaway and Jordan W. Cassell, October 1991.

ranging from $1 million – $5 million exceeded their target by 1.8 percent, and those greater than $5 million exceeded their target by 0.8 percent.

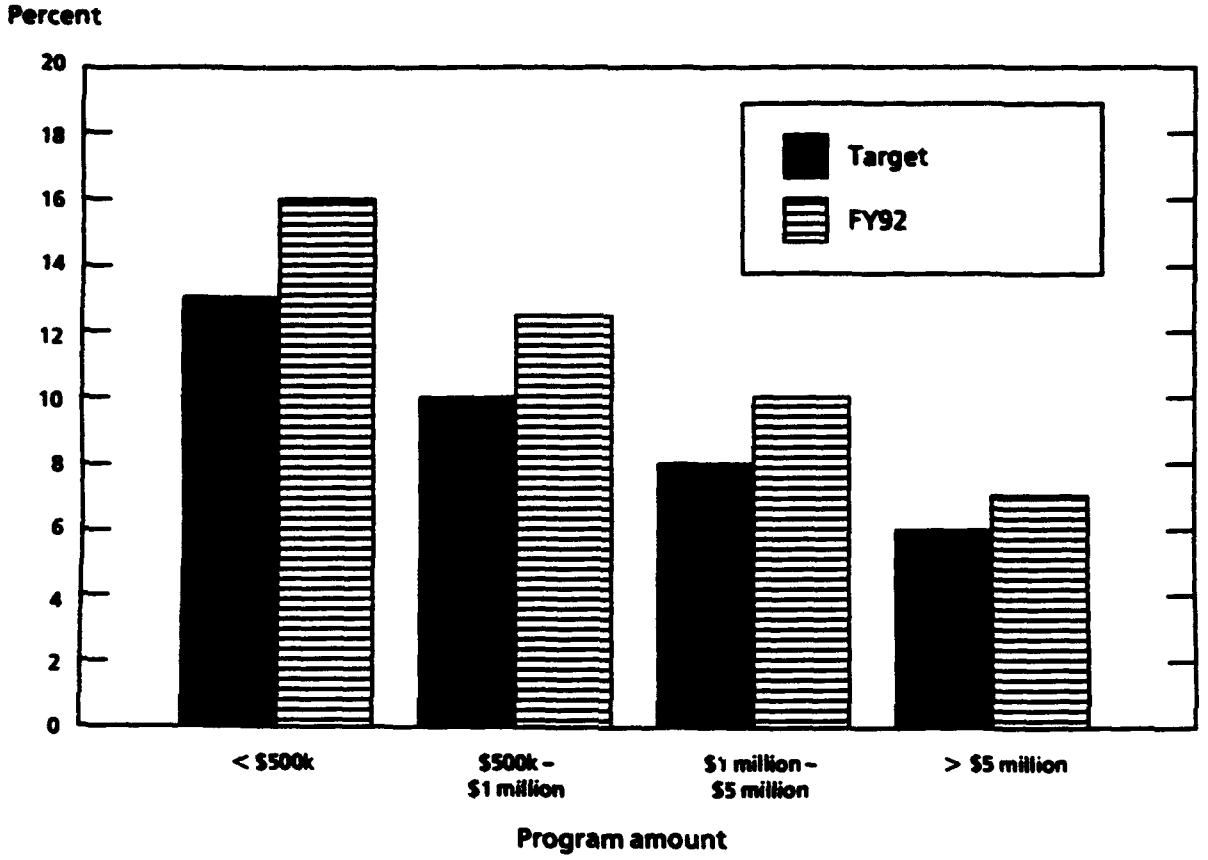


FIG. 2-1. PLANNING AND DESIGN PERFORMANCE – FY92 (P&D AS A PERCENT OF PA)

Translating the above performance rates into P&D dollars results in the summary shown in Figure 2-2. The sum of P&D dollars exceeding the targets for all size categories is $33 million. This chart clearly demonstrates that focus on P&D rates tells only part of the story. In the P&D rate chart of Figure 2-1, the small project size categories show the greatest mismatch with the target rates. However, in the P&D dollar chart of Figure 2-2, the program dollar value is much greater in the above-$5 million category, and therefore the effect on the total P&D dollar amount is far greater than for the smaller size categories. For example, a project programmed to cost $10 million would increase its P&D dollar requirement by $100,000 for each percentage point increase in the P&D rate. A project programmed at $500,000 would require only a $5,000 increase for each percentage point increase in the P&D rate.

Thus, a slight percentage difference in the large project categories has a significant impact on the total P&D dollar cost. From that observation, we conclude that effort to control costs on large projects will have a greater total dollar payback than on small projects.

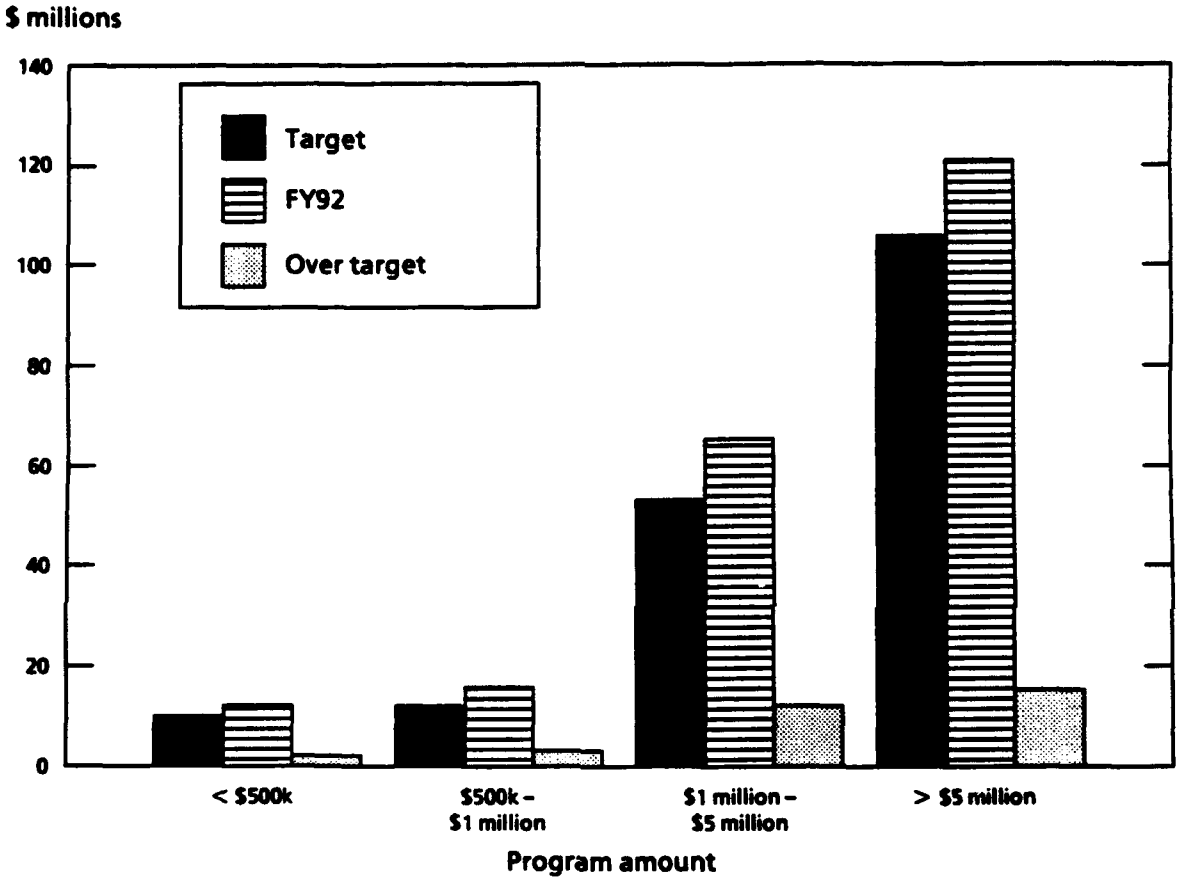


FIG. 2-2. PLANNING AND DESIGN DOLLARS – FY92

A snapshot of FY92 P&D performance need not be the sole basis for evaluating performance against a target. Utilizing the same FY92 target rates applied against prior years should provide a valid comparison of how satisfactory the targets may be. In Figure 2-3, we display 4 fiscal years of data comparing performance against the FY92 targets. This chart displays only the net effect of dollar variances, and we again see that the most dramatic impact occurs in the size categories above $1 million. Of greatest importance is the fact that the variance is generally

increasing over time. The FY92 variance is significantly greater than the FY89 variance.

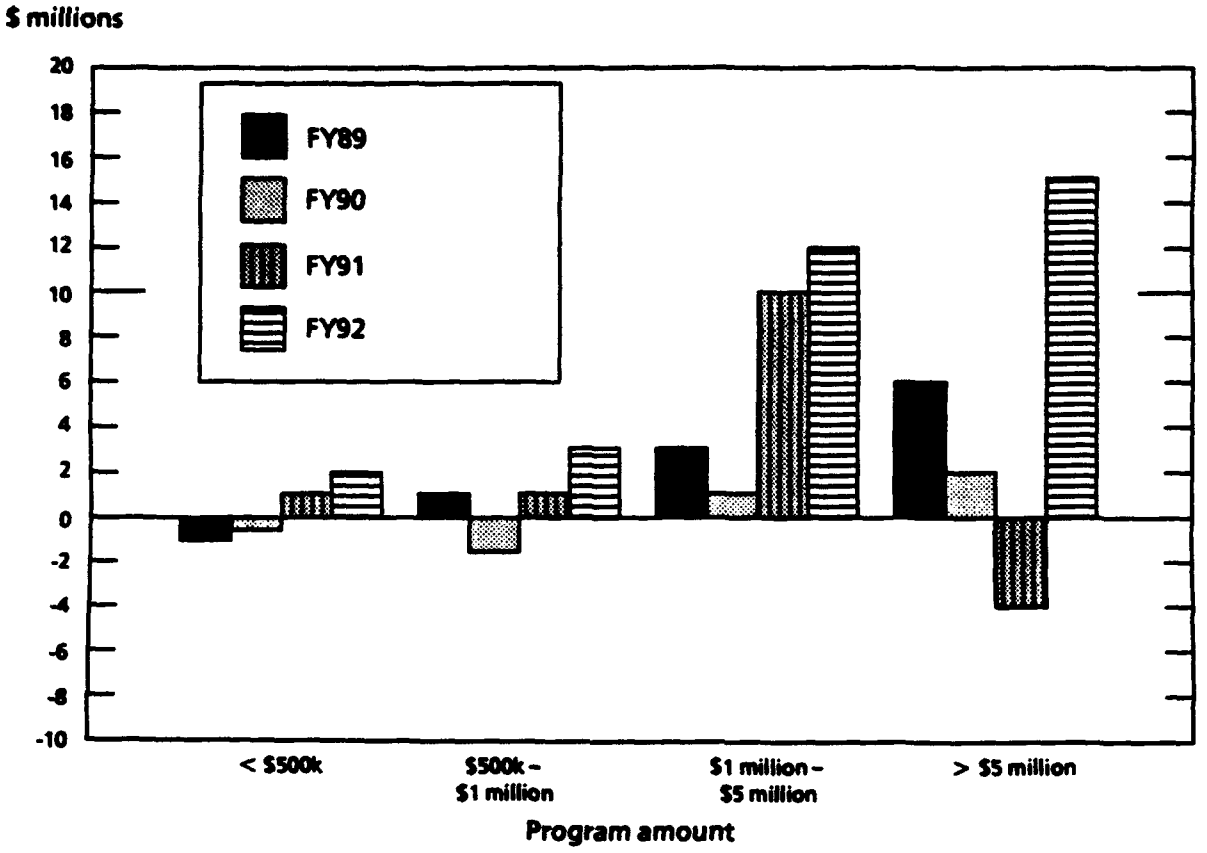


FIG. 2-3. PLANNING AND DESIGN VARIANCE FROM TARGET – FY89 THROUGH FY92

One anomaly shown with the FY91 projects greater than $5 million (performance is $5.7 million below the target) is explained by a target that appears to be significantly out of line. Three medical projects with a program amount of $413.7 million incurred design costs of $32.1 million or a rate of 7.75 percent. The target rate for medical projects over $5 million is 10.5 percent; thus, these three projects alone accounted for a positive variance of $11.3 million. Had the medical target rate been closer to the other MILCON rates (say in the 6 – 8 percent range), the overall FY91 P&D dollar rates would have been higher than the target rate, rather than below it.

TARGET ADJUSTMENT IS NEEDED

The foregoing leads us to conclude that the targets were challenging, as they were intended to be, and they need no major changes for continuing use. However, we do believe that some refinement is needed. The following subsections summarize those adjustments we consider important.

Size Categories

We believe the size categories of less than $500,000 and from $500,000 – $1 million can be combined into a single category of less than $1 million. Although the rates between the two categories differ significantly, the dollar impact of these smaller categories is comparatively low. It is important to minimize the amount of administrative effort in tracking targets and performance. Eliminating a size category will help simplify the tracking and recording process.

Fund-Type Categories

It appears that the number of fund-type categories can be reduced, either because of category similarities or because of the very few projects reported. The PBS category can be combined with the "Other" category since a comparatively small number of PBS projects are reported. The OMA and OMAF categories can also be combined since the nature of work accomplished under each is usually similar.

Target Rate Adjustments

The USACE intends the target rates to be both challenging and achievable. The key areas for change to ensure the rates meet those criteria are as follows:

- *Small projects*: Although the higher P&D rates associated with smaller projects have a smaller overall cost impact than do P&D rates for larger projects, those with high rates cannot be ignored. For small projects, we must apply special streamlining efforts that will slice through ponderous administrative processes. We believe that keeping the target rates in the vicinity of 10 percent for small projects will keep managers focused on these problems.

- *OMA/OMAF projects*: Many concerns have been expressed about the difficulties of designing certain O&M projects within the target rates. Notable among the examples given to substantiate such concerns are projects for the rehabilitation of older facilities that present structural problems, materiel problems (asbestos, for example), and electrical and

mechanical systems that do not comply with code. Those complex design problems, however, are offset by designs of other O&M projects that can be done at relatively low rates. Paving, roofing, fencing, and similar repair projects require a relatively small amount of design. Therefore, we believe it is appropriate to rely on the historical averages for O&M projects and keep the O&M targets at a relatively low rate.

- *DoD-M projects*: The relatively high target rate set for medical projects needs to be brought closer into line with other MILCON projects. While we believe in allowing for the complexity of medical projects, the target is a ratio of the program cost, and that cost represents expensive construction and installed equipment associated with the complex DoD-M program. Previous studies indicate the target rate for medical projects should average from 1 to 3 percent higher than MILCON programs.

We propose only minor adjustments for future rate setting. We recommend the target rates in Table 2-4 be used as a guide in making adjustments to the targets.

TABLE 2-4

CURRENT TARGETS AND RECOMMENDED FY94 GOALS

Fund type	Less than $1 million[a]		$1 million – $5 million		Greater than $5 million	
	Initial target[b]	Goal	Initial target[b]	Goal	Initial target[b]	Goals
MCA	.115	.110	.090	.085	.060	.055
MCAR	.100	.100	.075	.075	.045	.045
MCAF/AFR	.145	.120	.095	.090	.065	.060
Other[c]	.150	.110	.075	.065	.045	.045
FHA/FHAF	.080	.080	.045	.045	.015	.025
OMA/AF	.105	.100	.045	.045	.025	.025
DoD-M	.130	.140	.125	.120	.105	.075

[a] Size categories "less than $1 million" have been combined.

[b] FY92 targets shown are project-weighted for each combined category.

[c] PBS and Other have been combined.

Target Alternatives

An important consideration for USACE is to determine whether retaining a target for its O&M work is worth the administrative effort. O&M projects represent

about a third of the total USACE projects but less than 10 percent of the total project value. O&M projects vary widely in their design costs, and cost and schedule information reported in AMPRS is inconsistent. The Corps may find it is more effective to focus its P&D cost oversight on projects other than those funded by O&M. There is, however, a risk in not addressing O&M costs to measure design cost performance. Typically, customers are sensitive to the costs of O&M projects because they are funded out of local installation resources. An indicator that a district is less concerned with managing local projects than those funded by MILCON, for example, would be received poorly.

A second alternative is to consider restructuring the targets into smooth curves that would be similar to the curves contained in the P&D estimating model. Using curves would be more accurate than stepped rates and would permit project design estimates for customers to be more consistent with internal USACE P&D targets. However, formula-derived curves could increase target administration and become a source of confusion.

CHAPTER 3

IMPROVING PLANNING AND DESIGN COST PERFORMANCE

Information for this chapter was obtained primarily from field visits to five USACE districts: Sacramento, Mobile, Ft. Worth, Louisville, and Baltimore.[1] We present our findings, conclusions, and recommendations in the following five categories:

- Design process
- Information systems
- Design automation
- Other P&D cost factors
- Design quality management team.

DESIGN PROCESS

In contrast with the private sector, the government's requirement for design can be long and tedious. The principal reasons for the lengthy process are the requirements that work be procured fairly among all qualified design firms and that the public's interest be protected through sound investments in facilities that meet quality standards at competitive prices. Private-sector owners often use an A-E firm with which they become comfortable and develop a longstanding association. Such owners usually spend less time in reviewing the firm's work and frequently pay on a cost basis. While such arrangements can mean lower costs for the private-sector owner, the government is not permitted to conduct its business in that manner. All this affects P&D costs and presents special challenges to USACE design managers.

[1]LMI representatives were accompanied by representatives from the Sacramento District and the South Pacific Division. These organizations had already embarked on an intensive review of Sacramento's design costs and they believed they could get ideas from other districts to improve their design process. We believe this was a worthwhile effort and Sacramento has begun to initiate improvements based on the field visits.

Four areas have been singled out as major factors in the design process cost equation: project planning, A-E contracting, design reviews, programs and project management (PPM), and design interruptions.

Project Planning

District designers have less control of project planning than of any other military construction area. We found that no district is given planning information adequate for designing a project. Even though the customer bears the prime responsibility for providing that information, the districts, which are strongly oriented toward good customer relations, have been hesitant to push customers too far in the pursuit of better planning information. As a result, both A-E and in-house designers expend considerable effort (and P&D funds) to obtain those data as part of the design process. That effort significantly affects the design cost and time. Moreover, MILCON appropriation rules bar the use of P&D funds for project development activity; installations must utilize their own funds for that purpose.

The reasons the districts have inadequate planning information are as follows:

- *Army Project Development Brochures an Air Force Project Requirements and Management Plans.* These two documents outline the user's space requirements and support the programming documents, including Department of Defense Form 1391 used to justify MILCON projects to Congress. The project development brochures (PDBs) and project requirements and management plans (RAMPs) provide functional information needed by the designer, such as heating, ventilation, and air conditioning (HVAC); water; sewage; fire protection; storm drainage; curbs and gutters; and such special considerations as architectural treatment. They also include pertinent information such as references to master plans, utility maps, environmental constraints, and any peculiarities related to the work site. In summary, these documents provide evidence that the user has done the homework needed prior to beginning the design process.

Unfortunately, districts are not receiving customer documentation of the quality necessary to initiate design. Army PDBs are seldom submitted with projects and Air Force RAMPS lack substance. The installations are required to expend local funds (usually O&M) to prepare the project planning documents. If funds are short or staffing is limited, the installations submit only outlines of the required information, thus placing the burden of developing the planning information on the districts. Most districts have to use P&D funds to complete the planning information, an action not within the intent of the MILCON appropriation. As a result of the late planning

effort, project scopes and cost estimates are changed, often affecting project schedules and construction costs.

- *Installation Staffing.* Many reasons were given for not providing adequate planning information on projects; the primary one was the lack of staff at the installation level. That problem has been particularly acute at Air Force installations since the disestablishment of the Air Force Regional Civil Engineers (AFRCE) function. Air Force major commands have been unable to pick up the AFRCE workload and provide the same level of installation support service.

- *MILCON Project Lists.* Another factor has been the increase in the number of projects listed in the out-year programs. Under the philosophy that more is better and the chance of getting a few projects approved increases, many commands have loaded up the MILCON projects lists. That tactic places an added workload on the installations to identify and prepare project documents, even though they recognize the chances for funding are slim. In some cases, projects have been funded that the installation believed were no longer necessary. When installations spend effort to identify many projects, limited time is available to adequately plan those few projects most likely to be funded. Thus, as a project is approved, the required planning information must be obtained during the design preparation phase, and it is usually done with P&D funds.

The Army and Air Force can ill afford any waste in their facilities programs, particularly at a time when bases are being closed and consolidated. A minimum discipline needs to be imposed on the project planning phase of design. A project should not be entered into a MILCON program without a firm commitment from the user to a mission-essential requirement, adequate planning documentation, and confirmation that the project has a high probability of being funded. The USACE districts have the capability to provide project planning services and need to encourage customers to make better use of that capability. Customers need to request and fund those services up to a year in advance of the design start date. Major commands should certify to the USACE divisions that each project has the necessary planning documentation and the project will satisfy the mission requirement. After completing project reviews, the USACE divisions should certify to the districts that the project is ready for design.

Architect-Engineer Contracting

The leadership of the Corps is acutely aware that far too much time has been spent in acquiring A-E services. Surveys have indicated that often more time is spent

in acquiring the A-E services than is required to complete the design, and studies repeatedly confirm that costs always increase the longer a task is open to accumulate charges.

In 1990, USACE tasked LMI to review the A-E acquisition process and develop recommendations for streamlining it. Included in LMI's report[2] was a suggested flow process with standard steps and a duration period for each step of the contracting process. For example, for military construction projects whose design cost is less than $500,000, the maximum duration standard would be 123 calendar days from receipt of design directive until contract award. That represented a reduction of 69 days or 36 percent from the reported USACE average of 192 days.

A follow-up survey conducted in 1992 concluded that, while the Corps awareness of the need to make improvements in A-E contracting had increased, little evidence of any significant improvements could be found. The Corps should continue to emphasize reducing the time it takes to award an A-E contract. Managers and technical staff must be aware that projects delayed during the A-E contracting phase increase design costs and that the timeliness of product delivery is a key leg in the quality triad – satisfying needs, on time, and within budget.

A surge in design projects occurs after the annual appropriation is received, and that surge places peak demand on the A-E contracting staff. A recent change to increase the threshold of Business Clearance Memorandums from $100,000 to $500,000 will help to streamline the A-E contracting process.

We found another facet of A-E acquisition that could affect P&D costs. Under Brooks Act selection procedures wherein A-E firms are selected on the basis of qualifications rather than price, the prevalent belief is that to protect the virtues of the Brooks Act, negotiations must result in the lowest possible price for design services. A-E firms and district employees indicated to us that the districts sometimes carry that concept too far. Awarding a contract for a fair and reasonable price should not cause a design firm to assign its lowest graded employees to the job to break even. That action adversely affects quality and can result in higher cost either in design rework or, worse yet, for corrections during construction.

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[2]LMI Report CE003R1, *Streamlining the Architect-Engineer Acquisition Process*, Jordan W. Cassell, James L. Hathaway, and Robert A. Hutchinson, November 1990.

Finally, we note that districts who have very large populations of A-E firms from which to select, may award contracts to smaller firms only every 3 – 4 years. While providing opportunity to a broad base of the A-E community is good for smaller businesses, they are faced with a challenge. In spite of efforts to streamline procurement, a government contract still presents a formidable process, and to relearn the contracting process every 3 – 4 years is costly. Changes occur and new employees must be trained. The small firm often has difficulty in keeping abreast of the procurement process. Additional costs will be incurred by firms that do business with the government only occasionally, but USACE must continue its efforts to streamline procurement and reach out to help firms learn the intricacies of contracting.

Design Reviews

To follow the USACE criterion that 75 percent of the design work be contracted out to A-E firms, districts must devote a major share of their work effort to design reviews. From the customer's perspective, the Corps is responsible for the design, whether it is done in-house or by an A-E firm. Thus, district engineering staffs with large military workloads spend considerable time reviewing work done by A-E firms.

The question then is how much effort should this review process require? Many questions must be answered when deciding the extent of review:

- How experienced is the A-E firm?
- How well does the district know the firm's staff and their capabilities?
- Did the firm assign its most experienced people to perform the design?
- Is there an unusual technical feature of the project that requires special skills?
- Are the design calculations well organized and logical?
- Has the interface between the customer and the designer been smooth?

For projects done in-house, many of the factors are similar. Matching the qualifications of design team members with a project's special design requirements is important. Is the responsible designer experienced, or is frequent consultation required? Can the designer understand the customer's needs and communicate nis or

her ideas thoroughly? Knowledge of the designer's strengths and weaknesses will indicate the depth of design review required.

Skill levels and experience are not the only criteria that should govern the extent of review needed. In some design offices, it may seem perfectly natural for a coworker to review another designer's work. In other offices, that practice may be discouraged. Supervisor-subordinate and peer-peer relationships involve complex chemistry and what works in one office may not work in another.

No ironclad formula or set of rules can prescribe what will work in all design review cases. Judgment, experience, and common sense should be relied upon to govern the depth and scope of each design review effort. A reviewer who samples a few load calculations for energy requirements and finds the calculations to be correct and well organized may not have to review all the calculations. On the other hand, the reviewer who finds errors or work that is illogical may decide to continue the review or, if necessary, return the project to the designer for rework.

Reviewers can expend great effort to complete a design review and they need to draw a line to avoid becoming the designer through their review comments. We heard from a number of reviewers that they have been involved in projects in which the designer has deferred to the reviewers and simply fed back a finished product based solely on the reviewers' comments. This abrogation of the designer's responsibility not only wastes resources, but for A-E designed projects, it violates the terms of the A-E contract to deliver a professionally acceptable design product.

Districts have organized their review procedures using various methods, but the least desirable appears to be the establishment of a separate office devoted exclusively to the review function. Reviewing other designer's work, although very important, is typically a job few choose to do on a permanent basis. Moreover, designer's skills are sharpened most when they are performing the actual design. The preferred method we found is to assign reviews to groups that have in-house design capability and that can assign experienced designers to oversee reviews and train those less-experienced team members in review techniques.

We heard many comments about the process associated with customer reviews. Perhaps the greatest frustration resulted when a new customer representative inserted comments at the 60 percent review stage that should have been addressed during the project planning phase (hence, the need for more effective planning).

Districts are extremely sensitive to their customers' desires – sometimes to a fault. We believe this level of commitment to what is perceived as customer care has sometimes been a detriment to sound design management. Generally, eleventh hour roadblock comments can be avoided when a sound partnership arrangement with the customer is initiated at project inception.

We note that the Corps in its most recent initiative to restructure its design programs under technical centers has focused considerable effort on the design review process. Shared review responsibilities among the technical centers and districts having construction-only responsibilities magnify potential conflicts that can result when too many reviewers and organizations become involved. The review process requires carefully considered steps to ensure an efficient technical center review process.

Programs and Project Management

During our visits with the five USACE districts, we found PPM implemented in five different ways. That situation arises from the historically decentralized nature of Corps management. Imposing PPM on districts that have very different cultures and methods of operation has produced a hodgepodge of PPM organizations and procedures. Transferring PPM from the engineering organizations to the new PPM offices has caused significant turmoil and uncertainty. We found in some districts that additional layering had occurred since some engineering divisions retained and duplicated most of the project management functions. Although their team members retained different titles, such as technical manager, the functions remained essentially the same as those of PPM. In one district, plans were being developed to strip virtually all management functions from the engineering technical team members and assign those fully to PPM. The rationale for this approach was being driven by severe personnel ceiling and funding restrictions.

The most effective arrangement of PPM implementation resulted when a clear separation of responsibilities between the PPM and technical staffs was defined. A minimum management effort is required within the engineering/design organizations to schedule all workload, maximize the efficient use of staff, and oversee the technical quality of the design products. When that management responsibility is shared among each of the design teams and their members, they all become more productive and coordination between technical disciplines becomes

easier. The PPM organization must control the overall project budget, provide primary liaison with the customer, manage the schedule, and provide coordination for each of the planning, design, construction, and initial operation phases.

We believe that over time, most of the districts will weather the rocky start-up of PPM implementation and become more productive. During the implementation phase, however, PPM appears to have had a negative effect on the cost of P&D.

Design Interruptions

The congressional approval process for MILCON projects imposes phased submittals (preliminary to final) and workflow peaks that cause severe interruptions to the design process. Customer reviews add to these interruptions. Significant pressure is placed on initiating designs immediately after appropriations are passed to ensure that funds are obligated in the current year. Slow obligation rates reflect poor management and questionable requirements according to some budgeteers and congressional staff members. Since most A-E contracts retain options for proceeding from preliminary through final design, firms can anticipate delays between design phases and the possibility that a final design may not be funded. In spite of that fact of life, design flow interruptions are inefficient. Design teams must be reassigned to other work while awaiting customer review comments or congressional authorization. When the customer asks for additional reviews, the problem worsens. Although design interruptions have become a way of life for MILCON P&D, steps should be taken to minimize the effect and alert all MILCON decision-makers of the need to minimize and control design process interruptions.

Recommendations for Improving the Design Process

Project Planning

District staffs are fully capable of providing the planning support installations need to submit sound project planning information. We recommend an aggressive campaign be undertaken to familiarize customers with the costs and benefits of using that capability.

We also recommend that USACE demonstrate to higher authority the benefits of less costly designs with fewer design process interruptions that can result from an

improved planning process and that tighter restrictions prohibiting arbitrary changes to approved project scopes be initiated.

We recommend that PDBs and RAMPs be submitted for all projects and that their contents meet minimum standards before being certified by the major commands and USACE divisions as ready for design.

Architect-Engineer Contracting

Some districts do not place a high priority on the timely award of A-E contracts. We recommend the Corps reinforce its policy to achieve the time standards through status reporting at command management reviews (CMRs) and emphasis through other communication avenues.

Districts that have complied with the time standards should be recognized. We recommend publicizing the specific steps that districts have initiated to improve contract award procedures. We also recommend updating Engineer Regulation 715-1-5 to include streamlining techniques for contract award.

The USACE should encourage districts to create process action teams to review A-E contracting, identify bottlenecks, and improve throughput. This technique usually results in giving more authority and responsibility to employees in each division, branch, and section.

Design Reviews

Because the Corps assigns most of the design work for military programs to private firms, the design review function is a fundamental USACE responsibility requiring professional oversight and management control. Good designers also need to be good design reviewers. USACE design professionals should anticipate that learning to become a good reviewer is a part of their normal career growth requirements.

We recommend the review function become more imbedded into the activities of all design organizations. Career development should include training in review techniques. We also recommend an overhaul and consolidation of policy and

guidance on design reviews. Specifically, we recommend that the guidance that is developed do the following:

- Provide a system of checklists specifically targeted to the source of most of the design errors and omissions – the interface between design disciplines. One proprietary system known as "REDICHECK"[3] has proven its value in reducing construction change orders.
- Ensure that in-house reviews concentrate on scope conformance, life safety, economy of design, constructability, maintainability, and operability.
- Institute controls to ensure that A-E firms accept and act on their responsibility to provide quality products, including internal checklists and other quality control systems.
- Develop realistic budget estimates for review costs and ensure they are identified in each project management plan. Use those estimates to evaluate P&D review costs.

Programs and Project Management

Crafting a PPM role from within an organization with strong and effective traditions of managing projects separately during the design and construction phases has not been a simple task. We believe that USACE needs to demonstrate the benefits of implementing PPM, particularly the advantage of having a single point of contact through all phases (life cycle) of a project and the ability to pay increased attention to customers' needs. Permitting the design and engineering teams to concentrate more technical and less management effort on a project should result in lower overall costs to the customer.

We recommend USACE undertake a review of PPM implementation and determine what works and what does not. Concurrent with that review is the need to examine Engineer Regulation 5-7-1, *Project Management*, that implements PPM. We believe many lessons now being learned will influence changes that should be made in the PPM directive. Paramount in the review of PPM is the identification and restructuring of organizational elements that overlap and duplicate the same functions.

We recommend that USACE prepare a series of vignettes based on satisfied customers and team building to improve employee confidence in the PPM concept.

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[3]LCDR William T. Nigro, *The Navy Civil Engineer*. Summer 1986, page 8.

We recommend that designers focus on the benefits of concentrating greater effort on the actual design rather than the myriad administrative and funding responsibilities that should be handled by the PPM staff.

INFORMATION SYSTEMS

In seeking to define its needs in this age of abundant and often irrelevant information, the Corps has waged a vigorous battle to sift, sort, and standardize its information requirements. Most prominent among its efforts is the development of the Corps of Engineers Financial Management System (CEFMS). Its initial field test began in February 1993 at the Huntsville Division and culminates a 10-year effort to modernize the first leg of its information system. In the 1994 – 1995 time period, the Project Management Information System (PROMIS) is also scheduled for field testing.

The CEFMS will replace the outdated Corps of Engineers Management Information System (COEMIS), and PROMIS will replace AMPRS. Until both new systems are fully operational, the Corps will be forced to continue its management with less than fully satisfactory information. In its research during the past 6 years, LMI has noted the difficulty that USACE has in extracting management information from AMPRS and COEMIS to help it make effective decisions. Because of their size and impact on day-to-day operations, changes to COEMIS and AMPRS to keep abreast of technology require careful planning and extensive testing. We expect CEFMS will provide a quantum improvement in USACE information, but that improvement is not likely to be realized until 1995.

We found that field organizations have concluded that the current Corps-wide systems provide information of very limited value to them. They believe most of the systems only support upward reporting requirements. Managers who harbor that attitude are not overly concerned with the accuracy of district information entered into the systems. In more than one instance, we encountered views that the AMPRS reporting was more of a hindrance than a help to management. Reconciling labor hours with project data and cost reports becomes a major job requirement for some design managers, who see no local benefit arising from their effort. We also noted a reluctance to rely on data reported in AMPRS.

Local Information Systems

The advent of powerful personal computers (PCs) has become the solution for most districts that recognize the need for real-time management information. We found that all districts had instituted at least some form of management information systems outside the Corps central systems. The Mobile District has a highly effective system for budgeting and tracking design costs. We also found that some district systems were being used to feed central systems and verify the accuracy of their information. While these initiatives are to be applauded, each requires considerable resources, both for initial system development and for continuing maintenance. Clearly, such costs are imbedded in the costs of planning and design.

We conclude that USACE needs to accelerate its fielding of CEFMS and PROMIS. Far too much district effort, albeit out of necessity, is being devoted to development and maintenance of local management information systems.

Funds Information and Management

We found one of the most important difficulties with funding information was the lack of sufficient funds to initiate new projects. Corps policy requires that funds be withheld until a design project is fully scoped, even though a district must move quickly upon receipt of a design directive if it is to meet critical design milestones. This phenomenon has led design managers to charge time to other projects until they receive design funds for new projects. In principle, the design managers would then backcharge the new project to recoup funds "borrowed" from another job. That procedure results in sloppy administration, and very likely, it violates the statutory intent of an appropriation if the backcharge is not reconciled. That situation should be corrected.

Recommendations for Improving Information Systems

Most districts have concluded they cannot wait for CEFMS and have developed their own systems for internal information management. Even after CEFMS is introduced, we expect that it will take a long time for district personnel to learn the system, errors will be introduced in the transfer of data, and districts will need to operate some information systems in parallel rather than risk failure. The local systems in place will need to be relied on for at least a few years before the districts

have full confidence in the new system. We recommend USACE take steps to accelerate the transfer to CEFMS and PROMIS.

We recommend that directives for new design projects include a nominal amount – say, $10,000 – to cover design start-up costs and avoid reshuffling funds from other design projects and programs.

DESIGN AUTOMATION

Although its corporate information systems are struggling to catch up with technology, the opposite can be said of the Corps initiatives in design automation. We were most impressed with the actions taken by districts to streamline their in-house design capabilities through the use of computer-aided design and drafting (CADD) technology. Virtually all districts had considerable capability spread throughout their design offices, and two districts, Ft. Worth and Sacramento, have completely converted from drafting table to CADD.

Most design managers acknowledged they were far from exploiting the full design capabilities of their CADD systems but were making continuing progress and becoming more productive. Avoiding mechanical and structural system interference, automating quantity estimates, and responding to changes were a few advantages of the CADD cited by design managers. Another major advantage is the reduction of design errors during construction. One of the greatest benefits of having CADD systems at districts has been the ability to attract and retain highly motivated graduate engineers and architects. Most recent graduates had some experience with these systems during college and are able to become productive on the job almost immediately.

Another important benefit of CADD designs is their ease in recording as-built information. As record drawings are turned over to customers, they become a part of the installation archives and provide a valuable asset for future maintenance, repair, and modernization programs. This capability undoubtedly will become more valuable as customers acquire and expand their installation CADD systems.

The A-E community has also taken the CADD technology seriously. Most firms have at least limited in-house CADD capability or purchase CADD services when necessary. The Corps has had no problems with its requirement that A-E firms submit final plans in a format compatible with the Corps CADD standard. Since CADD technology has become very affordable through the use of highly capable,

low-cost PCs, it is unlikely that A-E firms will survive in the future without CADD capability.

During our research, we noted a variety of CADD systems being utilized by various design offices. Although USACE has procured Intergraph systems through a Corps-wide procurement, which includes significant hardware investment, many of the districts employ a lower cost AUTOCAD system based on PCs. Most offices employ a combination of systems with the rationale that while Intergraph offers the more capable system, some features of AUTOCAD are superior – notably in the applications supporting mechanical system design. We believe that in light of the major USACE commitment in its CADD procurement, it should have expected and received a more fully satisfactory system from its single procurement source.

Some managers have criticized the absence of a CADD detail library. (A detail library should not be confused with a CADD standards library. The Waterways Experiment Station at Vicksburg, Miss., successfully developed and manages a CADD standards library.) Most districts currently create their own design details and share them only within the district. Whether it be a simple structural connection detail or a complex, often-used electronic circuit design, some Corps designers believe that a sharing library for the entire Corps would be beneficial.

System Benefit-Cost Issues

We did not have enough current information from the districts or Headquarters to support a detailed benefit-cost analysis for the CADD investment. Although we describe the CADD benefits above, assigning a dollar value to them is a highly subjective endeavor. Annual hardware/software costs for 1993 were estimated at $4.2 million, but expenditures are estimated to decrease to about $2 million in 1994 and subsequent years for a number of reasons:

- Plans to consolidate USACE organizations will place increasing pressure on the Plant Replacement and Improvement Program – the primary source of CADD funds – for other consolidation investments.
- Most of the CADD procurement actions for initial outfitting have been taken.
- 1993 is the final year of a Corps-wide procurement contract for CADD.

Annual CADD maintenance costs have averaged about $3.5 million.

One of the more difficult elements of a cost assessment would be to determine personnel costs associated with CADD. Start-up costs for training, initial loss of productivity, and the need to run parallel systems when introducing CADD technology are usually greater than system acquisition costs. Fortunately, personnel costs should become lower in the future since an increasing number of Corps employees have become proficient in CADD operation.

An annual USACE expenditure of $5 million – $7 million for CADD hardware and software appears to be a modest investment. Considering that a sizable portion of that investment is associated with the civil works program (approximately 70 percent of civil works design is performed in-house, compared with 25 percent of the military program design), the military program receives economy-of-scale benefits that would be difficult to duplicate as an independent program. Since much of the private sector has also shifted to CADD, USACE would likely have had to make the CADD investment just to keep abreast of the industry – even if the benefits were not so apparent.

CADD Recommendations

Design automation has become a key component in the Corps ability to effectively produce quality design products. Nevertheless, it will require a continuing level of maintenance to keep up with technology. To be able to defend a recurring CADD investment stream will likely require that a more rigorous accounting of benefits and costs be maintained.

- We recommend as a minimum that district direct costs for CADD hardware, software, and training be collected and reported to the divisions. Those costs should be reported annually to HQUSACE.
- We recommend that HQUSACE develop and publish a set of goals for CADD technology defined in the context of expected benefits. Those goal statements should be used to judge the value added for each CADD investment.
- We recommend that USACE review its CADD procurement with Intergraph to determine whether a more fully capable product should be provided and, if so, to initiate actions that will enhance the full capability of its investment in the Intergraph system.

- We recommend that a clearing house for CADD details developed by districts be evaluated by a Corps center of expertise, i.e., the Waterways Experiment Station at Vicksburg.

OTHER P&D COST FACTORS

In addition to the areas already covered in this chapter, we have identified five separate factors that appear to be significant contributors to the cost of planning and design. Those factors are customer demands, reproduction costs, district and departmental overhead, billbacks, and criteria management. We believe that improvements can be made in each of those areas and have consolidated our recommendations at the end of this section.

Customer Demands

In providing planning and design services for their customers, USACE organizations must assign to their customers a prominent role during the process of planning and design. As in any team endeavor, however, the roles and competency of each team member must be defined if the team is to perform effectively. Therefore, unless the customer as a team member is well oriented and educated in the planning and design process, the customer may not necessarily be "always right."

Customers need to understand the basic processes that a design must follow and as a design progresses further, how much more difficult and costly changes become. Clearly, many changes are traceable to inadequate planning. One of the more sensitive areas facing designers occurs when the customer is directed to make changes by a new base commander who may not have been properly informed of the design process. Such a circumstance presents special challenges, and design teams need to be prepared to accelerate the new commander's planning and design education. Although we may never achieve zero defects in our planning, the earlier we detect and solve planning problems, the smoother the design process will become. The more a customer understands his or her role during that planning phase, the less likely are major changes during the later stages of design. Early education of the customer as a full and responsible partner on the planning and design team pays dividends throughout a project's life cycle.

Making the case for proper planning and assigning blame for most design changes on its absence is a fairly straightforward cause-and-effect relationship. But we need to caution against overreacting to this issue. Finding fault with planning

should not hinder making the correct decision to change when change is obviously required. It is always preferable to change planning before it becomes design, design before it becomes construction, and construction before it becomes an operating facility. Figure 3-1 illustrates the importance of investing up front.

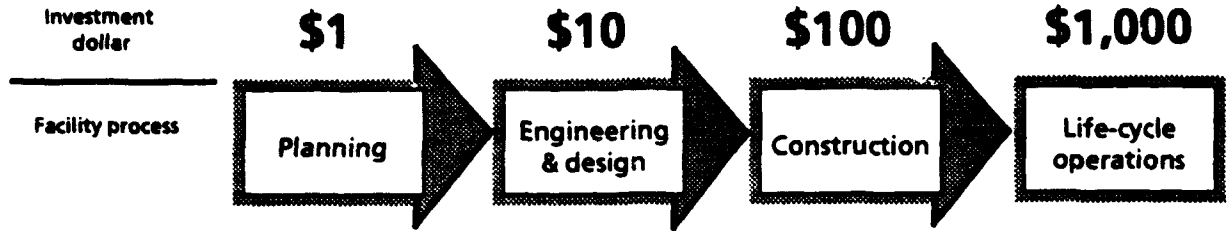

FIG. 3-1. INVEST UP FRONT – REAP DIVIDENDS LATER

In summary, we believe an educated customer can make a difference as a full partner in the planning and design process. By the same token, the customer always has the perspective of his or her requirement, and when that requirement is developed later in the design process than we would like, we must still be realistic about the long-term cost impact of our early planning and design decisions.

Reproduction Costs

The cost to reproduce plans and specifications has become a much more significant factor than we would have expected for three important reasons:

- Project managers strongly desire to have a sufficient supply of documents on hand so that when requests for bid packages are received, no delay is encountered by having to obtain additional sets through reprinting.
- Some printing operations have established minimum print runs, particularly for half-size prints, to achieve economic quantities.
- Districts tend to err on the generous side of in-house distribution.

In times past, it was always good business to ensure that sufficient copies of plans and specifications were on hand to satisfy the potential requests of many prospective bidders. The costs to print, handle, store, and ship this documentation were considered necessary but small compared with other P&D costs. The districts always assumed they had to have enough stock on hand to be responsive. In a

number of extreme cases, printing operations were geared to produce a minimum number of copies of documents because of unit-cost/economic-quantity factors, regardless of the customer's needs. If the district required only 50 sets of half-size plans but the government printing plant found that the unit cost dropped significantly if 100 sets were made, then the printer produced 100 sets. The district had no recourse but to receive and then dispose of the extra 50 sets.

At most districts, we also found a large number of full sets of plans and specifications being distributed internally to many offices. The district counsel, the safety office, contracting and real estate divisions, and each technical section received complete sets of plans and specifications. We doubt that extent of distribution is warranted. Moreover, most offices discard the material, since filing space is limited. We believe selective distribution of portions of the construction documents would be of greater service to all internal offices. Using that method would save not only reproduction costs, but time, since the receivers would be required to review and retain only those document sections that were meaningful to them. Full sets of plans then should be retained in a central repository for anyone to review.

As the government moves to streamline its operations, increasing the use of electronic files to distribute plans and specifications presents a real opportunity for reducing costs. Not only can printing and storage costs be reduced, but accuracy can be improved and the environmental impact from intense paper usage can be avoided. Designs prepared by A-E firms are required to be submitted in electronic formats, and the design and construction industry has become CADD literate. We believe increased use of electronic files is practical and cost savings from a reduced volume of hard copy information can be expected.

District and Departmental Overhead

Managers experiencing a decline in workload are faced with many difficult decisions, but the most difficult is how to restructure staffs, including discharging employees. Two adverse results of this decline can be prolonging the time spent on in-house projects, including design reviews, and charging available time to accounts that do not generate income, more specifically to overhead accounts.

In 1992, HQUSACE took steps to clarify the departmental component of district overhead, referred to as "technical indirect." It made a key decision to shift selected

overhead charges to direct charges; among those changes, the contracting division and the office of counsel now charge directly when their staff members work on specific projects. While such actions have not changed bottom-line P&D costs, they have added visibility to direct costs and, by reducing the base of departmental overhead, have made its use more conspicuous. Any business needs to have overhead accounts to allow for administration, training, and management functions and to accommodate effort to develop new work that has not been funded. Those accounts must, however, be controlled, and their use by employees normally engaged in direct labor tasks must be minimized.

Billbacks

One of the greatest concerns expressed by district design managers was the impact on P&D costs of "billback" charges. That term describes annual assessments allocated to each district to support Corps-wide centrally managed initiatives that are expected to ultimately benefit all USACE activities. The development of CEFMS, for example, has been supported through field participation and revenue generated from districts using annual billbacks as a primary source of funds. Valid arguments can be mustered to support the contention that the Corps would be better served if it sought central funding through other accounts, such as the Other Procurement, Army appropriation, to fund such major developmental initiatives. That procedure would reduce one element of the district total labor multiplier and present a lower charge rate to district customers.

Perhaps of even greater concern is a district perception that billbacks often support programs over which the district manager has little or no input and, more important, a belief that the district will receive no benefit. All districts must be partners in those centrally managed programs and have say in their management. Because of its experience in using a revolving account to fund its services, USACE is well positioned to move into the sphere of the new defense business operations fund (DBOF), whereby service organizations are required to charge fully burdened rates for all customer services. The structure of those rates, however, will be questioned by customers, and district managers must be prepared to defend and support each component of overhead. That defense must include the rationale for all billback charges taxed to support centrally managed programs.

We note that a draft Engineer Inspector General Report prepared in late 1992 was critical of USACE billbacks, specifically with regard to the apparent lack of controls in diverting project funds to centralized activities and the absence of accountability.

Criteria Management

Expenditures for managing criteria exceed $5 million annually, reflecting the high cost of keeping current with engineering, design, and construction technology. The HQUSACE staff retains primary oversight of the criteria function but utilizes a wide number of field offices to assist in keeping the criteria updated. A significant portion of the criteria is manifest in the *Corps of Engineers Guide Specifications* (CEGS) used by designers to tailor specifications for a specific design project. The CEGS is updated and published quarterly through the Construction Criteria Base (CCB), a private data base managed by the National Institute of Building Sciences, to provide current government and private standards and criteria to the entire design and construction industry. Subscribers receive quarterly issues on compact disks with read-only memory (CD-ROMs), and all district offices now subscribe to this service.

We found that the distribution of the CCB subscriptions is limited; often, not more than one or two copies are available in a district. Most of the specification tailoring effort involves translation of the CD-ROM data to other formats for local use. That translation process bypasses one of the powerful features of CCB – a software application titled SPECSINTACT. That application allows the user to tailor specifications and develop submittal requirements and offers a number of other helpful and time-saving features.

Another factor associated with criteria management is the continuing use of local guide specifications. USACE has attempted to eliminate any need for local criteria by improving the CEGS so that it is comprehensive and applicable to local requirements. We believe that most districts have been unwilling to make the changes necessary to use the CEGS exclusively because of inertia. Appropriate area criteria, such as state paving specifications, can be used in lieu of CEGS rather than have a local district attempt to rewrite area criteria as a substitute for CEGS.

We also found that most districts have published their own design guidance manuals for use by all A-E and in-house designers. Maintaining such documents is a

major chore and we question the need for each district to have separate and distinct documents. Much of the information contained in those manuals could be standardized across all districts. By applying the same logic as common CEGS, we believe that a national design manual could eliminate the need to prepare separate district versions. It would also unify the guidance to A-E firms that may prepare designs for more than one district. Guidance to designers would then be limited to project-specific criteria.

The volume of technical information, especially criteria, published by USACE is quite substantial. Although it is difficult to determine, we believe that the extent of duplication, lack of coordination among technical guidance documents, and failure to incorporate commercial standards and codes could be significant. A comprehensive review of USACE criteria documents has not been conducted.

Other Design Cost Factors Recommendations

Customer Demands

We recommend an information brochure for planning and design services be developed to help educate USACE customers, with emphasis on the role the customer plays in the planning and design process. District engineers and their project managers need to acquaint new installation commanders with their P&D services. During that initial indoctrination session, the district engineers should emphasize the importance of solid planning information and the impact of customer changes very late in the design process.

Reproduction Costs

The number of copies of plans and specifications for in-house distribution should be curtailed significantly. We recommend that a central repository be created, both electronically for specifications and in hard copy for plans. When a set of plans and specifications is ready to be advertised, possibly interested parties should be notified about the location and file access requirements where documents can be reviewed. For CADD-capable addressees, the entire set of plans could be made available electronically as needed. That action should significantly curtail the number of in-house copies of plans and specifications required for each project.

We recommend USACE explore with the Navy Printing and Publications Office – DoD's executive agent for printing – the capability to print on demand

those copies of plans and specifications that exceed a minimum first-run requirement for most projects or families of projects. A benefit-cost analysis should be initiated to determine any special costs associated with that capability and the expected benefit from such a venture. Private-sector firms frequently employ print-on-demand capability for cost minimization purposes.

District and Departmental Overhead

Efforts to contain and control overhead need to be managed on a Corps-wide and district-wide basis. No one organization or group of organizations can be charged with that responsibility and expect total success. We recommend that senior line managers (planning, engineering, construction, and operations) be asked to comment on overhead decisions in terms of the expected benefits to the production processes. Overhead requirements that cannot be justified on the basis of their contributions to the production of USACE services should, at a minimum, be questioned.

Billbacks

We recommend that a more rigorous disclosure policy be established to improve the acceptance of billbacks. Billback charges should not be a surprise, and those centrally funded programs that indeed have satisfactory rationale should be planned well in advance so that a district can incorporate their effect in its annual billing rates to customers and should be controlled with the same degree of scrutiny as are all other services produced by USACE for its customers. We suggest that project management plans be developed for all billback program initiatives. For those internal programs, the divisions and districts are the customers and they should expect and receive a quality product delivered on time and within budget just as any USACE customer expects and demands.

Criteria Management

We recommend that USACE make a concerted effort to curtail and eliminate the use of local district guide specifications. For districts that believe such a practice would be too disruptive, we recommend USACE establish a guide specification tiger team that could be dispatched to districts and assist in the transition to a CEGS-exclusive environment. For those bona fide cases in which the current CEGS is inadequate, a follow-on effort to prepare a more comprehensive CEGS may be

warranted. For those cases, the tiger team should be chartered to assist the district with that development.

We also recommend that HQUSACE initiate preparation of a national design manual that will eliminate the need for districts to prepare their own manuals. Many of these local documents could provide a starting basis for such a manual. Headquarters, USACE, should pick a few, combine the best features of each, and circulate a draft manual for comment. Once a document is acceptable, USACE can require all districts to conform to its provisions.

The above two recommendations could be best accomplished within the framework of a comprehensive Corps-wide criteria review. We recommend such a review be initiated to eliminate duplication and to ensure that criteria guidance is current and consistent with commercial standards and codes.

DESIGN QUALITY MANAGEMENT TEAM

Graduate schools of business management during the 1960s and 1970s sought to apply formula-based methods to improve management. Managing by objectives (MBO), including the measurement of progress and payment of rewards for achievement, typified the prescription for successful management practice. Formulas like MBO helped to encourage the segregation of tasks and functions. Insofar as each task or function was optimized within a master formula, the final outcome would also be optimum. Such management approaches led to greater specialization of the work force and encouraged managers to create highly functional groups within organizations. The theory was sound if each group worked to its designed level of performance and no mishaps occurred during the process. These management practices evolved around a concept of control, and the larger the organization, the greater the degree of centralized controls that was needed.

The inadequacy of formulas as the only need for good management was manifested in the 1980s in the form of a new global competitiveness. With its role suddenly challenged as the world's leader in productivity, American industry began to question the validity of its formula-based approach to management. Combining the concepts that the work force may have some better ideas about how to get a job done and that quality-based processes and products may be less expensive – particularly if they satisfy a customer – has led to new thinking. Workers, as members of product or project teams, are now encouraged to be aware of

the other "specialists" and to consider the effect that each worker's tasks have upon the other team members. Workers in this environment are far more likely to see processes that can be improved rather than functioning separately within their own areas of specialization. As members of a product or project team, the goals of the team are far easier to adopt than goals for a subordinate task or function.

The district planning and design processes are no less immune to this changing concept of management than a manufacturing operation in the private sector. Enveloped by specialization throughout its culture, a great sense of pride and professionalism has sprung from USACE's vast reservoir of specialized talent. But that reservoir now must be rechanneled to meet the needs of customers who demand quality products on time and within budget. The goals of partnership must now be pursued not only within its network of customers and contractors, they must be exploited within the fabric of the USACE district organizations. Hydrologists, architects, contract specialists, and information technicians all form the team, and under PPM, the project manager is the team leader. Recognizing each other's contributions to the team leads to mutual encouragement and a quest for continual improvement.

We found the partnership and team-building concepts work to varying degrees at the districts we visited. Some were at the stage of recognizing that the concept perhaps had merit and were interested in learning more. At the other end of the scale, we visited team leaders in the P&D organizations who were both enthusiastic about functioning in a team environment and committed to making the process better. The Louisville District exhibited a strong commitment to team building. The district received strong support from all the functional elements, and each functional representative was either an active team member or was committed to support process improvements initiated by the teams.

Team members knew each other's roles and backed up one another during periods of absence. If a foundation problem arose and it conflicted with site constraints, the architect and soils engineer collaborated to find the best team solution. Contracting and information requirements were viewed as internal customer needs and those functional area representatives signed on as team members. Team support promoted an atmosphere of challenging the way business was conducted and the need for outdated regulations and procedures. Through better

communication and a sense of each member's special talent, an environment for process improvement has been created.

Lest we create the illusion that this enlightened quality management team concept is a bed of roses – it is not. Many employees find the concept uncomfortable and threatening. Change is often difficult to accept. Some members forced to be on P&D teams simply will not participate. They do the minimal work required and are rebellious if another member questions progress or technical content. Negative team members can be disruptive, and managers usually attempt to carve out separate assignments for them rather than risk disruption. With the passage of time and influx of new employees, the numbers of those resisting change will decline and pres[illegible]e to partner as a productive team member will grow.

[illegible] was apparent that for those districts exhibiting a sound team-oriented philosophy, the concept had been fostered by leadership at the highest district level. Absent that personal involvement, the chances for making progress would have been far less. Committed leaders know that as good as their district employees are, they can, through quality management techniques, be even better. Embracing the principles of quality management requires top-down commitment.

We found that districts embarking on management change centered around team building are likely to achieve major improvement in the methods and processes used to produce USACE services. We strongly recommend that USACE initiate a quality management program building on the concepts of partnering, team development, and quality processes.

We recommend that, building on the experience of the HQUSACE process action teams established to help restructure district engineering and design organizations, the Corps promote and provide training as a first step toward institutionalizing and implementing the design quality team-building concept.

APPENDIX A

PLANNING AND DESIGN TARGET RATES
FISCAL YEARS 1992 - 1993

PLANNING AND DESIGN TARGET RATES
FISCAL YEARS 1992 – 1993

TABLE A-1

PLANNING AND DESIGN TARGET RATES
(Target rate = total design cost/programmed amount)

Fund type	PA less than $500k		PA equals $500k – $1 million		PA equals $1 million – $5 million		PA greater than $5 million	
	92 target	93 target	92 target	93 target	92 target	93 target	92 target	93 target
MCA	0.120	0.115	0.110	0.105	0.090	0.080	0.060	0.055
MCAR	0.100	0.095	0.095	0.090	0.075	0.070	0.045	0.045
MCAF/AFR	0.170	0.160	0.135	0.125	0.095	0.080	0.065	0.055
Other	0.155	0.150	0.115	0.105	0.075	0.070	0.040	0.040
PBS	0.170	0.150	0.115	0.105	0.075	0.070	0.065	0.060
FHA/FHAF	0.090	0.085	0.060	0.055	0.045	0.040	0.015	0.015
OMA	0.120	0.115	0.070	0.065	0.045	0.040	0.025	0.025
OMAF	0.090	0.085	0.070	0.065	0.040	0.040	0.025	0.025
DoD-M	0.150	0.145	0.125	0.120	0.125	0.120	0.105	0.095

Notes: PA = program amount; MCA = Military Construction, Army; MCAR = Military Construction, Army Reserve; MCAF/AFR = Military Construction, Air Force/Air Force Reserve; Other = Military Construction, Other; PBS = Production Base Support; FHA/FHAF = Family Housing, Army/Air Force; OMA = Operation and Maintenance, Army; OMAF = Operation and Maintenance, Air Force; and DoD-M = Department of Defense, Medical.

APPENDIX B

DIVISION/DISTRICT COMMENTS ON PLANNING AND DESIGN TARGETS

DIVISION/DISTRICT COMMENTS ON PLANNING AND DESIGN TARGETS

A 21 July 1991 memorandum sent to eight U.S. Army Corps of Engineers (USACE) divisions and their districts proposed planning and design (P&D) targets for FY92 and FY93. The responses are summarized below:

1. The engineering divisions cannot control all of the P&D costs; many are associated with the district overhead and other external influences, such as customer and Headquarters requirements.

2. Customers are doing a very poor job of defining their requirements prior to starting design projects. Most requirements have to be redefined during the early stages of design and that effort gets charged to the P&D cost. The effort is usually a requirement to be funded by the customer from some other fund source, such as operations and maintenance (O&M).

3. Designs are becoming much more sophisticated than in past years requiring the latest material technologies and construction methods. Complex controls for heating, ventilating, and air conditioning (HVAC) systems; increased attention to energy efficiency; access for the handicapped; drawings produced by computer-aided design and drafting (CADD) systems; and imbedded communications and computer systems are some of the expanded design requirements.

4. Establishing the new programs and project management offices has added costs and duplicated of some management functions within the districts.

5. Removal of the design review responsibilities from the divisions has added P&D costs at the district level, since those reviews had been funded by O&M positions provided by USACE Headquarters.

6. Districts are penalized by an increase in lost design, caused primarily by customer changes, that is not discounted to the cost of P&D.

7. Small projects have a disproportionately high fixed cost associated with A-E selection; contract administration; site visits and conferences; progress and cost reporting; reproduction costs; buildability, constructability, and operability reviews; and A-E performance evaluation and liability.

8. Studies to justify selection of systems (e.g., HVAC systems; intrusion detection systems; and energy monitoring and control systems energy

budgets, fuels, and fire protection systems) represent major P&D costs and are usually superfluous.

9. The design process is strongly affected by the start-stop requirements associated with customer changes, funding delays, and lack of authorization to proceed with design. Substituting other (filler) work causes it to be ineffective, often interrupts the larger design projects, and is a source of lost design.

10. The Corps should make greater use of standard designs.

11. Some customers, notably the Air Force, are very demanding in the services they require. For example, Air Force projects

    a. are often for complex weapon systems, and final requirements are not known until the system is fully operational;

    b. require frequent reviews, conferences, and briefings, even though the new RAMP process anticipates going from preconcept directly to final design review;

    c. demand increased design services, including multiple submissions, renderings, comprehensive interior design, landscaping, and operation and maintenance manuals; and

    d. specify state-of-the-art design criteria, materials, and facilities with imbedded fiber-optic and computer systems.

12. Measurement of design costs for O&M projects is not worthwhile since there is great variability among those project types.

13. The USACE should reduce the amount of upward reporting and provide greater flexibility (and trust) to the districts for local management decisions. Adding the upward reporting requirements for P&D targets increases that burden.

14. The new USACE management and reporting systems (CEFMS, PROMIS, ARMS, and CEAP)[1] are becoming increasingly costly, and there is no indication that duplication of information reporting through each of the Corps stovepipes will be improved.

15. The cost of "billbacks," or charges for those centrally managed activities over which the districts have no control but are charged to project planning

[1]CEFMS = Corps of Engineers Financial Management System; PROMIS = Project Management Information System; ARMS = Automated Review Management System; and CEAP = Corps of Engineers Automation Program.

and design costs, represents a significant increase to P&D that has doubtful benefit for the design programs.

16. Frequent changes in top management, at the district, division, Headquarters, and customer levels often result in changes in direction that affect P&D costs. Those changed directions are often viewed as capricious and arbitrary.

17. Too much focus on the costs of planning and design will detract from producing a quality product that satisfies the customer and will likely result in facilities that ultimately will cost more because of higher construction and life-cycle operation and maintenance costs.

APPENDIX C

COMPOSITION OF FUND TYPES FOR PLANNING AND DESIGN TARGETS

COMPOSITION OF FUND TYPES FOR PLANNING AND DESIGN TARGET

TARGET	FUND TYPE[1]
MCA	Military Construction, Army
	02 – Base Closure Program, Part I, Army (BRAC I)
	07 – Base Closure Program, Part II, Army (BRAC 91)
	10 – Military Construction, Army
	11 – Military Construction, Army – Minor Construction
	1S – Military Construction, Southern Command (Panama)
	17 – Military Construction, Army National Guard
	98 – Troop Support Agency, Headquarters
	99 – Troop Support Agency, Local
MCAR	Military Construction, Army Reserve
	06 – Military Construction, Army Reserve Minor
	12 – Military Construction, Army Reserve
MCAF/AFR	Military Construction, Air Force/Air Force Reserve
	03 – Base Closure Program, Part I, Air Force
	08 – Base Closure Program, Part II, Air Force
	20 – Military Construction Program, Air Force
	21 – Military Construction, Air Force Reserve
	23 – Minor Construction, Air Force
	25 – Military Construction, Air National Guard
	29 – Military Construction, Air Force (MX)
	2R – Peacekeeper, Rail Garrison Air Force
	2S – Small Missile Construction, Air Force
Other	Military Construction, Other
	04 – Base Closure Program, Part I, Other
	09 – Base Closure Program, Part II, Other
	16 – Cemetery Fund
	19 – Other Army Funds
	27 – Non-Appropriated Funds, Air Force
	28 – Other Air Force Funds
	30 – Military Construction, Navy
	31 – Other Navy Funds (Host Nation)
	32 – Navy and Marine Corps Reserve
	35 – Non-Appropriated Funds, Navy
	36 – Plant Replacement and Improvement
	41 – Department of Defense Agencies
	47 – Voice of America
	48 – Defense Language Institute

[1] *AMPRS Data Dictionary*, Engineer Publication 415-345-2, CEMP-CM, 31 December 1990.

TARGET	FUND TYPE
Other	Military Construction, Other (continued) 50 – National Aeronautics and Space Administration 51 – Department of Defense Dependent Schools 5S – MILCON Section 6 Schools (CONUS) 53 – Defense Communication Electrical Education Testing Activity 54 – Defense Logistics Agency 55 – Department of Energy 56 – Defense Mapping Agency 58 – Defense Communications Agency 59 – Other Non-Defense Federal Funds 60 – Non-Appropriated Funds, Army 61 – Modernization of U.S. Facilities, Germany 62 – Alternate Construction, Germany 64 – Army/Air Force Exchange Construction, Headquarters 65 – Army/Air Force Exchange Construction, Local 66 – U.S. Soldiers and Airmen's Home 69 – National Security Agency 82 – Non-Appropriated Army, Local
PBS	Production Base Support 15 – Production Base Support
FHA/FHAF	Family Housing, Army/Air Force 26 – Family Housing, Air Force 40 – Family Housing, New Construction 42 – Family Housing – Line Item Improvement 44 – Family Housing – Energy Conservation Investment Program 45 – Family Housing – Maintenance and Repair
OMA	Operation and Maintenance, Army 14 – Operation and Maintenance, Army 18 – Operation and Maintenance, Army Reserve
OMAF	Operation and Maintenance, Air Force 24 – Operation and Maintenance, Air Force 49 – Operation and Maintenance, Department of Defense
DOD-M	Department of Defense, Medical 43 – DOD Medical Facilities, Unspecified Minor 46 – Department of Defense Medical Facilities

APPENDIX D

COMPOSITE DESIGN INDEX

COMPOSITE DESIGN INDEX

TABLE D-1

CALCULATION OF COMPOSITE DESIGN INDEX

(Sample district workload)

Fund type	Total PA (all projects) $000	P&D target rate – FY92	Target design cost (all projects) $000	Actual design (all projects) $000
Projects with PA < $500k				
OMA (40 projects)	12,000	0.120	1,440	1,500
OMAF (25 projects)	10,000	0.090	900	1,000
Subtotals			2,340	2,500
Projects with PA = $1,000k to $5,000k				
MCA (18 projects)	55,000	0.090	4,950	4,750
MCAF (24 projects)	60,000	0.095	5,700	5,850
Subtotals			10,650	10,600
Projects with PA > $5,000k				
DoD-M (2 projects)	25,000	0.105	2,625	2,600
MCAR (1 project)	10,000	0.045	450	500
Subtotals	N/A	N/A	3,075	3,100
Total	N/A	N/A	16,065	16,200

Notes: PA = program amount; P&D = planning and design; OMA = Operation and Maintenance, Army; OMAF = Operation and Maintenance, Air Force; MCA = Military Construction, Army; MCAF = Military Construction, Air Force; DoD-M = Department of Defense, Medical; and MCAR = Military Construction, Army Reserve.

$$\text{Composite design index} = \frac{\text{Total actual design cost}}{\text{Total target design cost}}$$

$$= \frac{\$16{,}200\text{k}}{\$16{,}065\text{k}}$$

$$= 1.01$$

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James L. Hathaway, Jordan W. Cassell

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)

Logistics Management Institute
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Headquarters, U.S. Army Corps of Engineers, establishes policy and provides guidance for the design and construction of military and Civil Works programs. Inefficiencies have been experienced in the design process, resulting in part from a declining workload and shrinking resources. This report identifies some key areas needing improvement, including project planning, the architect-engineering contracting process, design reviews, information systems, as well as other cost impact areas.

We have recommended some key steps that will help curtail costs and improve the effectiveness of the design process. Customers should improve their project planning and reduce the amount of changes after the design has been started. If districts achieve the A-E contracting time duration standards published by Headquarters, significant improvement in awarding contracts will result. Funds should be available to districts to initiate design earlier, and centrally managed programs need to be planned for more effective district participation. These and other improvement areas can be more readily achieved at districts that are emphasizing team building and are focused on continually improving their design process.

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